

REMARKS/ARGUMENTS

Favorable reconsideration of this application in light of the following discussion is respectfully requested.

Claims 1-17 are currently pending in the application. Claims 5-17 are withdrawn; Claim 1 is amended; and Claim 3 is canceled without prejudice or disclaimer by the present amendment. Support for amended Claim 1 can be found in the original specification, claims and drawings.¹ Thus, no new matter is presented.

The outstanding Office Action, Claims 1 and 3 were objected to because of minor informalities; Fig. 8 was objected to as not being labeled as background art; Claim 1 was rejected under 35 U.S.C. § 102(b) as being anticipated by Mitani et al. (U.S. Patent No. 6,191,463, hereinafter “Mitani”); and Claims 2, 3, and 4 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Mitani.

In response to the objection to the drawings, submitted herewith is a Letter Submitting Drawing Sheets along with a Replacement Sheet for Fig. 8 adding the legend “Background Art” to Fig. 8. Accordingly, Applicants respectfully request that the objection to Fig. 8 be withdrawn.

Claim 1 was objected to because the format of the original claims caused the phrase “source and drain” to appear to read as “sourceanddrain”. In response Claim 1 is amended to clarify that the claimed feature is “source and drain” rather than “sourceanddrain”. Further, Claim 3 is canceled, and therefore the objection thereto is rendered moot. Accordingly, Applicants respectfully submit that the outstanding objections to the claims be withdrawn.

Applicant respectfully submits that amended Claim 1 states novel features clearly not taught or rendered obvious by the applied references.

¹ Specification at page 5, lines 14-32.

Claim 1 relates to the structure of a semiconductor device in which the hard breakdown lifetime of the gate dielectric film can be lengthened by causing the gate dielectric film to endure a soft breakdown. Specifically, the concentration of impurity in the gate dielectric film is intentionally fluctuated to cause the soft breakdown of the gate dielectric film to occur.

Amended Claim 1 recites, *inter alia*, a semiconductor device, comprising:

“an insulating layer...
containing impurity atoms in such a manner that a
concentration thereof is non-uniformly distributed... by setting a
maximum concentration of the impurity atoms in the surface to
more than twice a minimum concentration thereof.”

Applicant has experimentally confirmed that the dielectric breakdown of the gate dielectric film is maintained to be within the range of the soft breakdown, if the maximum concentration of the impurity is equal to or greater than twice the minimum concentration thereof. Thus, according to the structure of the semiconductor device as recited in amended Claim 1, it is possible to lengthen the lifetime of the gate dielectric film.

In contrast, Mitani, in Fig. 32A-32M describes that the fluorine atom impurity is introduced in the first gate insulating film (3a) and the second gate insulating film (3b). Mitani neither discloses nor suggests the processing for non-uniformly distributing concentration of the impurity in the insulating films (3a) and (3b), but instead describes that concentration of the impurity is introduced equally on the whole surface of the substrate.²

In Mitani, the silicon thermal oxide films (2) are arranged on both sides of the insulating films (3a) and (3b), and heights of the insulating films (3a) and (3b) change in vicinity of the films (2). Due this configuration, concentration of the impurity change slightly, however, Mitani fails to teach or suggest that the maximum concentration of the impurity is equal to or greater than twice the minimum concentration of the impurity, as

² Mitani at col. 34, line 55-col. 35, line 7.

recited in amended Claim 1. Specifically, the outstanding Official Action cites col. 35, lines 1-6 of Mitani and states that “a highest concentration of the impurity atoms is equal to the lowest concentration”. This is in clear contrast to the above-noted feature recited in amended Claim 1.

The outstanding Official Action further states that “it would have been obvious to one of ordinary skill in the art... to determine the workable or optimal value or range of the highest concentration for the impurity atoms through routine experimentation...” However, Mitani fails to teach or suggest, at any point, that the soft breakdown of the gate dielectric film is effective to lengthen the gate dielectric film, as described in relation to the present claims. Therefore, it would not have been obvious to one of ordinary skill in the art to experiment with the impurity concentrations of Mitani to arrive at a level which induces a soft breakdown.

Based on Applicant’s experimental knowledge, when the concentration of the impurity is introduced by Mitani’s method, concentration of the impurity in the gate dielectric film only fluctuates 4-5%. Accordingly, utilizing Mitani’s method, it is not possible to change the maximum concentration of the impurity to be more than twice the minimum impurity level, as recited in amended Claim 1.

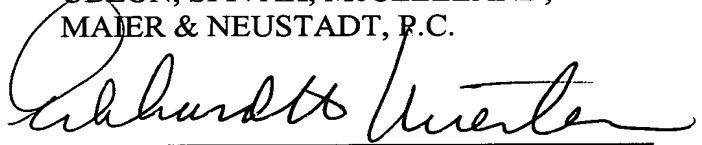
Further, Mitani is not concerned with altering the level of impurities to initiate a soft breakdown of the gate dielectric film whatsoever, and since the concentration level of the impurities using Mitani’s method could only render a fluctuation of 4-5% it would not be possible, much less obvious to arrive at Applicant’s claimed invention. Therefore, the present invention is not obvious from the descriptions of Mitani.

Accordingly, Applicant respectfully requests that the rejection of Claim 1 under 35 U.S.C. § 102(b) be withdrawn. Further, as Claims 2 and 4 depend from amended Claim 1, it is also submitted that these claims patentably define over Mitani.

Consequently, in view of the present amendment and in light of the foregoing comments, it is respectfully submitted that the invention defined by Claims 1, 2 and 4 is definite and patentably distinguishing over the applied references. The present application is therefore believed to be in condition for formal allowance and an early and favorable reconsideration of the application is therefore requested.

Respectfully submitted,

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A handwritten signature in black ink, appearing to read 'Eckhard H. Kuesters', written over a horizontal line.

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IN THE DRAWINGS

The attached sheet of drawings includes changes to Fig. 8. This sheet, which includes Fig. 8, replaces the original sheet including Fig. 8.

Attachment: Replacement Sheet (1)